

\*Technical...  
take good notes!  
(Assumes a LOT from Alg. 1)  
Will continue Wed.

### Geometry 3.6

Find the distance between a point and a line\*

Find the distance between parallel lines\*

pythagorean theorem

hypotenuse

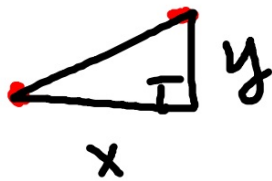
distance

parallel //

perpendicular  $\perp$

equidistant

same distance



$$x^2 + y^2 = h^2$$

(Wed?)

construction: perpendicular from a point not on a line

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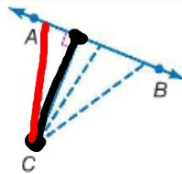
...because it is the shortest...  
(why?)



**KeyConcept** Distance Between a Point and a Line

**Words** The distance between a line and a point not on the line is the length of the segment perpendicular to the line from the point.

**Model**

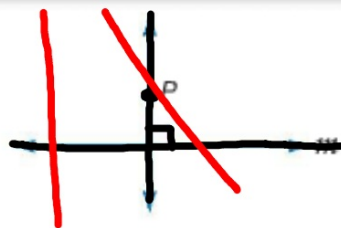


q. 216 constr.

**Postulate 3.6** Perpendicular Postulate

**Words** If given a line and a point not on the line, then there exists exactly one line through the point that is perpendicular to the given line.

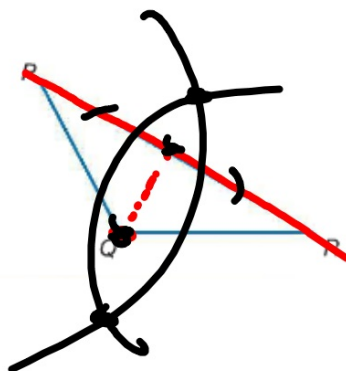
**Model**



**Guided Practice**

1. Copy the figure. Then **construct** and name the segment that represents the distance from  $Q$  to  $\overleftrightarrow{PR}$ .

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**Example 2** Distance from a Point to a Line on Coordinate Plane

**COORDINATE GEOMETRY** Line  $\ell$  contains points  $(-5, 3)$  and  $(4, -6)$ . Find the distance between line  $\ell$  and point  $P(2, 4)$ .

Always graph and estimate first.

**S-ish**

\* Covered in Algebra 1 (separately...now all in same problem!) You need a plan!

1. Write eq. of  $n \perp \ell$

Slope  $\ell$   $\frac{-6-3}{4-(-5)} = \frac{-9}{9} = -1$

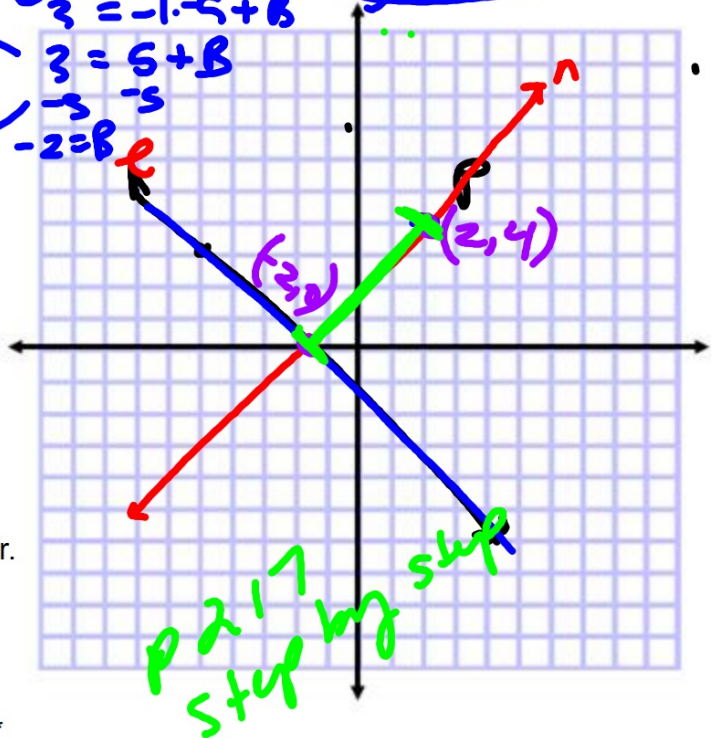
$y = mx + B$   
 $3 = -1 \cdot (-5) + B$   
 $3 = 5 + B$   
 $-2 = B$

$y = -1x - 2$

$n$ : Slope = 1  $(2, 4)$

$y = mx + B$   
 $4 = 1 \cdot 2 + B$   
 $4 = 2 + B$   
 $-2 = -2$   
 $B = 2$

**$y = x + 2$**



1. You know 1 ord. pair, you need the other ord. pair.
2. Find the equation of line  $l$ \*
3. Find the equation of line  $p$  (perp. to  $l$ )\*
4. Find the point of intersection of  $p$  and  $l$ \*  
(You now know the other ord. pr.)
5. Find the distance (Pyth. theor.) with 2 ord. pairs.\*

(A)  $y = x + 2$

(B)  $y = -x - 2$

$(-2, 0)$

$0 = x + 2$   
 $-2 = x$

$dy = dx$

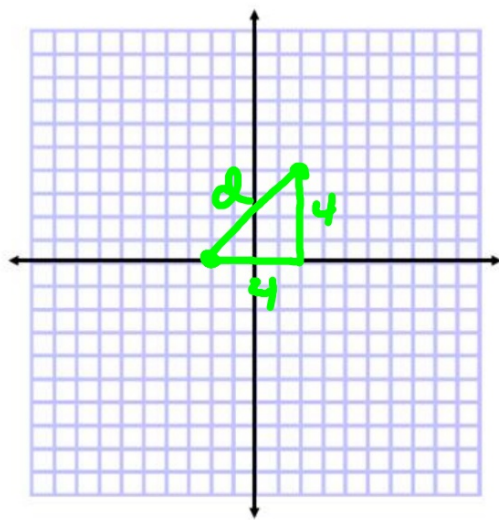
$y = x$

$4^2 + 4^2 = d^2$

$16 + 16 = d^2$

$32 = d^2$

$5.7 \approx d$



COORDINATE GEOMETRY Find the distance from  $P$  to  $\ell$ .

4. Line  $\ell$  contains points  $(4, 3)$  and  $(-2, 0)$ . Point  $P$  has coordinates  $(3, 10)$ .

$$\ell = y = mx + B$$

$$m = \frac{3}{6} = \frac{1}{2}$$

$$y = \frac{1}{2}x + 1$$

$$0 = \frac{1}{2} \cdot -2 + B$$

$$0 = -1 + B$$

$$1 = B$$

$$n \quad y = -2x + 16$$

$$6 - 16$$

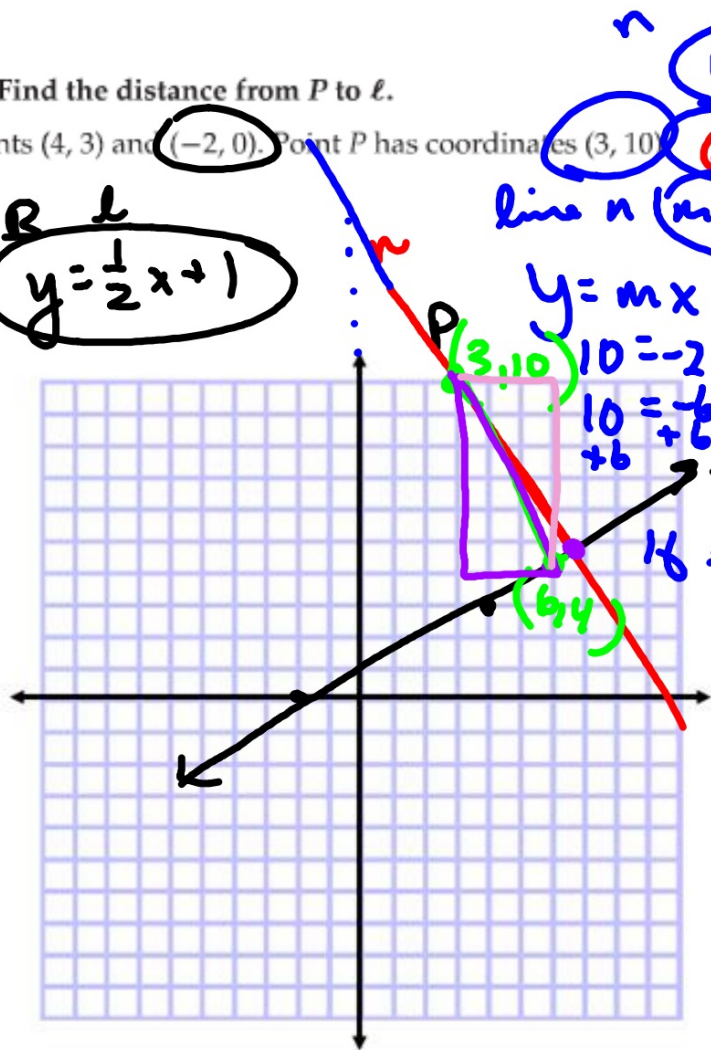
$$\text{line } n \quad m = -2$$

$$y = mx + B$$

$$10 = -2 \cdot 3 + B$$

$$10 = -6 + B$$

$$16 = B$$

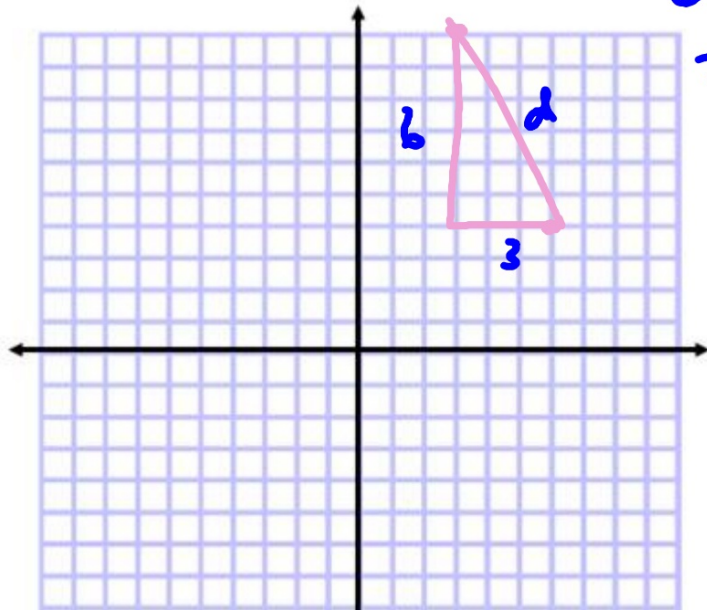


$$y = \frac{1}{2}x + 1 \quad y = -2x + 16 \quad (6, 4)$$

$$\frac{1}{2}x + 1 = -2x + 16$$

+1x -1 +2x -1

$$y = -2 \cdot 6 + 16$$
$$4 = -12 + 16$$



$$6^2 + 3^2 = d^2$$

$$36 + 9 = d^2$$

$$\sqrt{45} = \sqrt{d^2}$$

$$6.7 = d$$



## Whiteboards:

1. You know 1 ord. pair, you need the other ord. pr.
2. Find the equation of line  $l^*$
3. Find the equation of line  $p$  (perp. to  $l$ )\*
4. Find the point of intersection of  $p$  and  $l^*$   
(You now know the other ord. pr.)
5. Find the distance (Pyth. theor.) with 2 ord. pairs.\*

5. Line  $\ell$  contains points  $(-6, 1)$  and  $(9, -4)$ . Point  $P$  has coordinates  $(4, 1)$ .

6. Line  $\ell$  contains points  $(4, 18)$  and  $(-2, 9)$ . Point  $P$  has coordinates  $(-9, 5)$ .

### **KeyConcept** Distance Between Parallel Lines

The distance between two parallel lines is the perpendicular distance between one of the lines and any point on the other line.

Is the y-intercept a point on the line?

Can we know what it is from the equation?

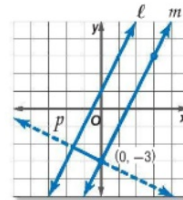
### Example 3 Distance Between Parallel Lines



Find the distance between the parallel lines  $\ell$  and  $m$  with equations  $y = 2x + 1$  and  $y = 2x - 3$ , respectively.

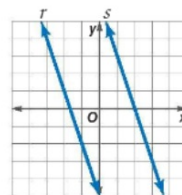
\* Covered in Algebra 1  
(separately...now all in  
same problem!)  
You need a plan!

1. Pick one line, call it  $m$
2. Write the equation of line  $p$  perp to  $m$ \*
3. Find the point of intersection of  $l$  and  $p$ \*
- (Now you know 2 points)
4. Use pyth theorem to find distance\*



### Guided Practice

- 3A. Find the distance between the parallel lines  $r$  and  $s$  whose equations are  $y = -3x - 5$  and  $y = -3x + 6$ , respectively.



**Theorem 3.9** Two Lines Equidistant from a Third

In a plane, if two lines are each equidistant from a third line, then the two lines are parallel to each other.

